Measure: Purchasing Incentives for Zero Emission Vehicles and Plug-in Hybrid Vehicles **(**T7)

A fee-bate structure is created for the period 2011-2020 that collects fees from general- or transportation-related activities (e.g. vehicle registrations, sales taxes) that are used to provide sufficient funds (~$22.65 million) for rebates (average of $3,850/vehicle) to Tucson citizens and organizations to purchase Zero Emission Vehicles (ZEVs, a.k.a. all-electric vehicles or EVs) and PHEVs (plug-in hybrid electric vehicles).

The measure's goal is to triple Tucson purchases of ZEVs and PHEVs from 2011-2020 compared to the "business as usual" scenario in which Tucson purchases are just Pima County's share of the national market for new vehicle sales (0.21%). The measure is expected to result in 5,835 ZEV/PHEV vehicle purchases beyond business-as-usual during the 2011-2020 timeframe.

Emission reduction potential in 2020:	10,780 tCO_2e
Percentage of goal (2012):	0.006%
Percentage of goal (2020):	0.48%
Total annual average implementation costs:	$0 due to revenue neutral fee-bate system covering rebates and administration
Entity that bears the costs of implementation:	Revenue neutral fees are proposed to pay for program, meaning costs are borne by fee payers – likely to be citizens of Tucson but potentially including visitors if sales tax used
Cost/Savings per tCO_2e:	Savings of $10 / tCO2e
Net annual savings:	$ 0.65 million
Entity that realizes the financial return:	Zero-emission / PHEV Vehicle owners
Equitability (progressive/regressive, income/revenue neutral, etc):	Depends on source of implementation costs. Example: Regressive if fees from all auto registrants are used. Progressive if fees on inefficient new car sales are used.
Potential unintended consequences:	Slight potential for reduced economic activity as a consequence of the fees that fund the fee-bates

Background information:

This measure is predicated on two factors, one human and one physical. First, consumers will often respond to sale prices, or "deals" even to the point of altering purchase locations due to small differences in local sales taxes, especially on major purchases like appliances or vehicles.

Second, a direct relationship exists between a vehicle's energy consumption and its carbon emissions, meaning that dramatic GHG reductions per capita can occur through leaps in the fuel-efficiency of vehicles. ZEVs are projected to average 100 miles per gallon equivalent (MPGe) and PHEVs to average 80 MPGe, whereas the average MPG in Tucson today is ~20 for gasoline vehicles.[1]

Arizona is one of 13 states that adopted the California standards defining Low-Emission Vehicles (LEVs) and Zero-Emission Vehicles (ZEVs). ZEVs operate with electricity as the vehicle's sole fuel, though the specific propulsion system in the vehicle may be batteries, hydrogen fuel-cells or compressed air piston engines.

Plug-in electric hybrids (PHEVs) are designed to operate solely on their electric batteries until they are discharged, after which the vehicles will use a petroleum-based (gasoline or diesel) engine to generate electricity. Like ZEVs, they are propelled solely by electric motors, whereas today's gasoline hybrids are propelled by either a petroleum engine or electric motors, depending on the situation.

ZEVs and PHEVs are also called Grid-enabled Vehicles (GEVs) because their sole or primary fuel comes from the nation's electric grid.

ZEVs may achieve about three to six times the vehicle fuel efficiency of regular gasoline fueled vehicles. The Nissan Leaf has received an EPA miles-per-gallon equivalent (MPGe) rating of 99;[2] lighter-weight prototypes such as the Motive Kestrel or Aptera may achieve 200+ MPGe.[3]

ZEV efficiency greatly varies according to weight, aerodynamic drag, and specific conditions such as weight of loads, topography, electric loads (especially air conditioning) and driving style. The wide variance of electric vehicle fuel efficiency for a single battery charge is shown by Nissan's stated range for the Leaf's 24 kilowatt-hour battery pack: 62 to 138 miles.[4]

The cost of lithium-ion batteries is the primary barrier to ZEVs and PHEVs being cost-effective for buyers. It is estimated that current models' battery packs are costing manufacturers $600-850 per kilowatt-hour (kWh), whereas Nissan needs to achieve $370/kWh for its Leaf model to be profitable, which many experts predict will take a decade. The US Department of Energy projects that PHEVs will need battery costs from $168-280/kWh to be cost-competitive.[5]

In this analysis, Westmoreland Associates estimates ZEVs to achieve 100 MPGe and PHEVs 80 MPGe. The resulting CO_2 emission savings per vehicle per year compared to a 30 MPG gasoline vehicle, assuming 10,000 miles driven per year and ZEVs/PHEVs substitute for gasoline vehicles, would be:

ZEV: 4,597 pounds CO_2; 70% reduction,
PHEV: 4,104 " "; 63% reduction.

This does not take into account the carbon intensity of coal and the use of coal for ~50% of US electricity generation. An Argonne National Labs lifecycle estimate of the "well to wheel" carbon emissions of a ZEV found only an estimated one-third reduction in carbon emissions from a gasoline vehicle, largely because of that consideraion.[6]

Another study by the Electric Power Research Institute collaborating with the National Resources Defense Council estimated a range of 29% lifecycle emissions reduction from gasoline for ZEVs using coal-fired electricity to 67% reduction if using renewable-sourced electricity.[7]

These vehicles (e.g. the PHEV Chevy Volt or Toyota Prius models, to be launched in 2011, or retrofitted gasoline hybrids) will require numerous advanced technologies and a lithium-ion battery-pack costing ~$10,000 in the near-term, giving a significant upfront cost disadvantage. The retail price of the ZEV Nissan Leaf is $32,500; the PHEV Chevy Volt $41,000. In addition, owners may wish to invest ~$2,000 in rapid charging infrastructure at vehicle storage sites at their homes or fleet service sites.

This report recommends that Tucson, Pima County and the State of Arizona collaborate to follow the lead of various states that consider ZEVs or PHEVs worthy of major financial incentives of at least $5,000 when coupled with the Federal government's incentive of $7,500.

To illustrate the ZEV initial cost challenges, expected through at least 2012 if not the entire decade, the table below shows the number of miles that a ZEV vehicle (modeled on the Nissan Leaf) must be driven to save the owner as much in fuel costs as the owner has paid in higher purchase costs. The ZEV is compared to a gasoline vehicle achieving 30 MPG and costing either $15,000 or $20,000.

The scenarios address current Federal purchase rebates of $7,500 and additional rebates of $5,000 offered by some states (total of $12,500). The analysis uses the retail cost of a Nissan Leaf ZEV of $32,500 and fuel efficiency estimated at 100 MPGe using electricity costing the national average of ~$.10/kWh. Maintenance costs are assumed to be identical, though some experts predict maintenance costs for ZEVs to be lower than for regular vehicles.

Gasoline costs are the US average of $2.82 for 2010, and a hypothetical $4.00 in the future. Note that Westmoreland Associates has projected Tucson gasoline costs to be $3.01/gallon in 2011 rising to $4.09 by 2016 and $4.37 by 2020.

Table 1: ZEV Miles of Fuel Savings to Breakeven from Higher Purchase Costs

Scenario	Miles to Breakeven*	
ZEV cost: $32,500		
Comparable gasoline car cost:	**$15,000**	**$20,000**
Gasoline price $2.82/gallon, no rebates	254,000	181,000
Gasoline price $4/gallon, no rebates	162,000	115,000
Gasoline price $2.82/gallon, $7,500 rebate	145,000	72,000
Gasoline price $4/gallon, $7,500 rebate	92,000	46,000
Gasoline price $2.82/gallon, $12,500 rebates	72,000	0
Gasoline price $4/gallon, $12,500 rebates	46,000	0

* - Number of miles required at fuel savings based on 10 cents per kilowatt hour electricity costs to achieve a breakeven point where the initial higher cost of the vehicle is saved through fuel savings.

Table 2 below shows the same comparisons as Table 1 but for a PHEV assumed to achieve 80 MPGe combined while driven 40% on electric batteries (meaning achievement of 66 MPG during the 60% of miles using gasoline), and an initial purchase cost of $35,000.[8] Note that the Chevy Volt was rated at only 37 MPG on gasoline by the EPA; Westmoreland's assumption of 66 MPG is based on tests of lighter-weight PHEV designs that will achieve higher gasoline MPG.

Table 2: PHEV Miles of Fuel Savings to Breakeven from Higher Purchase Costs

Scenario	Miles to Breakeven*	
PHEV cost: $35,000		
Comparable gasoline car cost:	**$15,000**	**$20,000**
Gasoline price $2.82/gallon, no rebates	343,000	257,000
Gasoline price $4/gallon, no rebates	230,000	172,000
Gasoline price $2.82/gallon, $7,500 rebate	214,000	128,000
Gasoline price $4/gallon, $7,500 rebate	144,000	86,000
Gasoline price $2.82/gallon, $12,500 rebates	129,000	43,000
Gasoline price $4/gallon, $12,500 rebates	86,000	29,000

* - Number of miles required at fuel savings based on 10 cents per kilowatt hour electricity costs to achieve a breakeven point where the initial higher cost of the vehicle is saved through fuel savings.

Assuming that most consumers will want their initial higher cost investment for a ZEV or PHEV to be paid back within 75,000 miles, the only scenarios that will are likely to result in ZEV/PHEV sales to average vehicle buyers are those with Federal and State rebates totaling ~$12,500 unless consumers compare the ZEV or PHEV to a $20,000 gasoline car instead of a $15,000 car and if/when gasoline prices rise above $4 per gallon. The US Department of Energy does not consider that likely before 2015.

Regarding future gasoline prices:

- The official predictor of future US energy prices is the US Energy Information Administration's annual Energy Outlook. The 2010 Outlook predicts the most likely scenario (a.k.a. its "Reference case") of average US gasoline prices in 2015 to be $3.07/gallon. If global factors keep oil prices low, the US gasoline price is predicted to be $2.06/gallon; the "high oil price" scenario predicts $4.19/gallon. The wide range illustrates the great uncertainty in energy markets.[9] The EIA's short-term outlook for 2011 published January 2011 predicts a national average of $3.17/gallon for 2011 and $3.29 for 2012.[10]

- The average US gasoline price predicted by the modeling of The Electrification Coalition is $3.35/gallon for 2012; $4.17/gallon for 2015; and $4.56/gallon for 2020.[11]

- Westmoreland Associates has projected Tucson gasoline prices 2011-2020, pegging Tucson prices as 5% below the US EIA projection for 2011 of $3.17/gallon and thereafter 5% below the Electrification Coalition projections.[12]

In short, the most likely scenario for adoption of high efficiency PHEV and ZEV vehicles is very slow marketplace penetration unless petroleum prices rise faster than presently expected.

The role of government rebates is therefore more crucial in reducing carbon emissions from PHEV/ZEV vehicles until a combination of economies of scale that reduce vehicle production costs plus higher petroleum prices make these vehicles financially attractive to mainstream buyers.

Based on the following, this report does not conclude that a lack of publicly available charging stations will hinder purchases of PHEV/ZEV vehicles, so this carbon emissions reduction measure does not include incentives for charging station development.

- City of Tucson's participation in the EV Project managed by Ecotality USA.

- Projections by vendors that owners of commercial charging stations will obtain favorable return-on-investment rates; and

- The likelihood that vehicle fleets and citizens using PHEV/ZEV vehicles will provide their own charging infrastructure; and

- The likelihood that people with driving needs greater than the range of a ZEV will avoid purchasing ZEVs. They will instead purchase regular petroleum vehicles or PHEVs with typical vehicle ranges. This minimizes the need for daytime charging stations, at least in the near-term.

Description of Measure:

This ZEV/PHEV incentive measure could be described through several performance metrics of its effectiveness compared to a "business as usual" case without City intervention. One of these measures needs to be chosen as the lead indicator.

- Achieve a xx% reduction of the City's GHGs inventory through greater vehicle fuel efficiencies.

- Achieve a yy% annual increase in City resident, business and fleet-owned vehicles that achieve an specific efficiency goal, such as 30 or 35 average MPG (or its equivalent).

- Achieve a zz% increase in new ZEV and/or plug-in hybrid purchases or conversions.

The core problem with each of these indicators is establishment of the "business-as-usual" case of what is likely to occur without City intervention. The ZEV and PHEV markets are frontier markets with no historic precedents from which to draw reliable predictions.

A 2010 market prediction report by J.D. Power[13] projected slow growth of ZEVs in the US to 2020 for various reasons, particularly their high cost. Its surveys showed that although 17% of people initially express interest in a ZEV, the interest shrinks to 5% when they are informed of the $15,000 additional purchase price. The purchase barriers include the following (in parentheses are the % of survey respondents giving it as a reason for "lack of interest"; only the top three reasons were reported):

- Purchase cost premium (37%)

- Limited range (17%)

- Costs of ownership, including perceptions of continued electricity price increases or high costs of recharging (10%)

- Reduced power and performance, especially in hilly areas

- Battery charging infrastructure and length of battery recharging time

- Electricity-generation emissions (noted to be of interest only to strong green buyers)

The J.D. Power report predicts that while the US market for hybrid-electric vehicles, including PHEVs, will steadily grow to 1.67 million units by 2020 (nearly 10% of the US new vehicle market), ZEVs will grow only to 107,000 units by 2020, less than 1% of the new car market, with initial rapid growth to 2014 leveling off at about 80,000 units total for the rest of the decade.

The need for financial incentives for ZEVs and PHEVs is validated by consumer research in 2009 from the University of Michigan, which asked consumers about their willingness to pay extra for a vehicle obtaining 75% fuel savings over a gasoline engine. At a $2,500 premium, 46% said they would be willing; at $5,000, 30% expressed willingness, and at $10,000, only 14%.[14]

The City of Tucson is a partner in the EV Project managed by Ecotality USA. The project is committed to accomplish the following:

- Open a network of electric vehicle charging stations by summer 2011 that includes 180 residential charging stations, 230 Level 2 “Blink” stations, and 10 DC Fast Chargers.

- Make 900 Nissan Leafs available to Phoenix- and Tucson-area owners starting in December 2010 at project roll-out. The vehicles are being marketed to Tucson-area owners with a potential free home charger installation, but no other purchase incentives.

The “business as usual” scenario also includes the State of Arizona’s reduced licensing fee incentive for purchase of alternate fueled vehicles (AFVs), including electricity. The incentive reduces the annual licensing costs to negligible levels between $5 and $10, whereas comparable new petroleum-fueled vehicles (assuming $20,000 purchase price) will pay ~$1200 in licensing fees over the vehicle’s first five years. The ~$1150 difference reduces the miles needed to breakeven for ZEVs, using the assumptions in the analysis above.

In summary, this report finds the “business as usual” ZEV scenario for Tucson for coming years to be characterized by:

- Adequate electric charging infrastructure

- Inadequate incentives to promote purchase of ZEVs, which will not be cost-competitive without them.

This report has selected the third option listed: a ZEV/PHEV deployment goal for the City/region that is triple the new car sales that would normally be expected to occur given the region's population (data used: Pima county light-duty vehicle registrations as a percentage of total US light-duty vehicle registrations, 0.21% of the US total) and predicted US ZEV/PHEV sales estimates by J.D. Power.

This analysis uses J.D. Power's projections for US sales of ZEVs and hybrid-electric vehicles. It assumes that 5% of hybrid electric vehicles purchased in the US are PHEVs, and the remaining 95% are gasoline or diesel hybrids that do not use the electric grid (today's hybrids). J.D. Power predicted 1.67 million hybrid sales and 107,000 ZEV sales, in 2020.[15]

Westmoreland Associates recommends that the Tucson program not provide incentives for purchase of hybrids that are not primarily operating off of electricity from the grid, since they are surviving in the marketplace without incentives today.

The goal to 2020 is 3195 more ZEVs in the region than the business-as-usual projection, and 2640 more PHEVs.

Three options are offered for City consideration:

- Sales tax exemption at the point of sale of a ZEV, which could be applied to new and/or used vehicles
- Rebates (tax or sale price) that modify the consumer's costs of purchase
- Income tax credits for owners

The specific option chosen is not as important as the actual amount of cost reduction achieved, which must be enough to induce owners to purchase ZEVs or PHEVs.

Based on the $5,000 rebates offered by various states, which brings the initial cost of a Nissan Leaf to a tolerable breakeven at 72,000 miles at current gasoline prices, and assuming that the existing State of Arizona licensing incentive for AFVs continues to provide an ~$1,150 cost savings over five years that is seen as such by consumers, this report estimates that the Pima county region needs to offer an purchase incentive (rebate) worth $3,850 to ZEV/PHEV consumers.

Given the projected additional costs of $8,500 for the PHEV Chevy Volt compared to the Nissan Leaf, this incentive may not be enough to stimulate Volt sales, though it may stimulate sales of lesser-priced PHEVs expected to be marketed later in 2011.

A key question for regional decision-makers is whether any City/county/regional incentives for ZEV purchase should be given in addition to existing Federal rebates, or whether they should take effect only after eligibility for those rebates has closed, when

potential consumers will face a much higher number of miles before breaking even on initial costs.

An alternative strategy for the City would be to help the State of Arizona establish a more meaningful state incentive (e.g. $5000 per vehicle) for electric vehicles (or in some cases, gasoline-electric hybrids), which 16 states have done as of November 2010.

The analysis that follows is focused on supplementing expected Federal rebates for the years 2011 to 2013 with $3,850 per vehicle such that total rebates are $12,500 for 441 vehicles.

To continue the program such that Pima County's share of ZEV/PHEV sales tripled the expected share (a total of 5835 vehicles)of the US market from 2011-2020, the total funds required at $3,850 per vehicle would be ~$22.3 million. With projected administration costs, the measure's costs are estimated to be $22.65 million.

A primary question for Pima County decision-makers is the source of the funds. This report recommends consideration of a "fee-bate" program in which fees are increased for some transportation options – or for other sources of greenhouse gases. These fees then fund the rebates.

The City or County's options will be limited by state statutes, but likely includes options such as auto registration fees or utility rights of way fee surcharges (used by City of Boulder, CO, to fund its Climate Action Plan). A vehicle parking/registration fee is used by the City of Chicago, where each vehicle registered to a City resident is required to pay a $50 annual parking fee.

Other options include: (1) a dedicated sales tax increase on non-AFV vehicle sales; (2) increased registration fees for non-AFVs; or (3) increased petroleum or fossil fuel consumption taxes.

Vehicle parking/registration fee scenario for Pima County:

Approximately 515,000 light-duty vehicles were registered in Pima County as of September 2010. A vehicle parking/registration fee of $10 per year would raise ~$5.15 million/yr. that could be used to subsidize ZEV/PHEV purchases in the region.

A $10 vehicle parking/registration fee for less than five years would raise the $22.65 million required for this measure. If decision-makers concluded that ZEVs/PHEVs would only require subsidies of $3850 per vehicle for five years, the vehicle registration fee could be halved to $5/year, or the duration of the fee reduced to slightly over two years.

Has the Measure been implemented elsewhere and with what results?:

City/county/regional fees to subsidize ZEVs/PHEVs have not been implemented.

Implementation scenario(s):

The goal of tripling (or more) business-as-usual deployment of ZEVs/PHEVs would need countywide or citywide adoption by governments, including a revenue source.

The implementation would ideally begin with 2011 purchases to help insure that the purchase incentive is combined with the Federal purchase rebate of $7,500, which is limited to initial purchases and may not be extended. Tucson may choose to increase the vehicle incentive beyond $3,850 when Federal subsidies expire so there is sufficient incentive for vehicle purchases at the desired rate of triple the expected share of the US market.

Energy/Emission analysis:

On a tailpipe emission basis, ZEVs and PHEVs operating on electricity will create near zero CO2 emissions attributable to the City of Tucson unless CO2 emitting operations within the City generate the electricity (some small emissions may result from battery operations or use of lubricants).

In this report, ZEVs are estimated to average 100 MPGe, PHEVs are estimated to achieve 80 MPGe, and a regular gasoline vehicle will achieve 30 MPG. Though approximately 7% of vehicle fuels used in Pima County are diesel, the analysis has been simplified by comparing ZEVs and PHEVs to gasoline only since gasoline vehicles are the most likely alternative for vehicle purchasers. The analysis assumes that a vehicle in the Pima County area is driven 12,000 miles per year and has a 10-year life.

Resulting CO_2 emission savings per vehicle per year compared to 30 MPG vehicle:

ZEV:	4,597	pounds CO2
PHEV:	4,104	“ “

Achieving the goal of tripling business-as-usual sales of ZEVs and PHEVs will result in the following additional deployment of vehicles and annual GHG savings; note that the “CO2 Emission Savings Beyond-BAU Vehicles” includes vehicles sold in previous years beyond the business-as-usual projections.

Table 3: CO_2 Emission Savings, Purchasing Incentives Program, in tCO2e

Year	ZEVs Sold Beyond BAU	PHEVs Sold Beyond BAU	CO_2 Emission Savings New Sales (tCO2e)*	CO_2 Emission Savings Beyond-BAU Vehicles (tCO2e)
2011	42	84	2,882	2,882
2012	168	147	7,372	10,254
2013	294	210	11,862	22,116
2014	336	252	13,820	35,936
2015	344	294	14,941	50,877
2016	353	315	15,625	66,502
2017	378	315	16,241	82,743
2018	403	336	17,318	100,061
2019	428	336	17,934	117,995
2020	449	351	18,781	136,777

* - assumes 6 months of savings in year purchased

The climate change impact summary below only gives the vehicles' GHG reduction credit for the year in which they operate, and assumes vehicles purchased 2011 through 2020 are still operating in Tucson in 2020.

Climate Change Impact Summary:

COT 1990 Citywide GHG emissions (baseline):	5,461,020 tCO_2e
MCPA 7% reduction target for COT:	5,078,749
2012 BAU GHG emissions projection:	7,000,000
2020 BAU GHG emissions projection:	7,343,141
GHG emissions reduction to meet 7% goal (2012):	1,921,251
GHG emissions reduction to meet 7% goal (2020):	2,264,392
Contribution of this Measure:	122 in 2012, 10,780 in 2020

Report authors recommend that City of Tucson also conduct a lifecycle emissions analysis to reflect the emissions generated to recharge ZEV/PHEV batteries, which are not included in the above calculation, which is based on tailpipe emissions only. While the City's main concern is GHGs emitted by City-based activities, programs such as this

need to consider the full lifecycle of the sustainable technology being promoted such that overall global sustainability performance is enhanced.

Economic analysis:

Note: The economic analysis uses the lifetime of savings from an investment by a Tucson citizen to reduce climate change impacts, whereas the climate impacts section above only used the actual GHG savings each year to 2020.

Measure Costs

The local rebates to ZEV/PHEV buyers are assumed to be an average of $3,850 per vehicle, totaling $22.65 million over ten years. These costs, plus administrative costs of approximately 0.25 FTE or ~$250,000 over ten years, are assumed to be borne by vehicle-related fees, such as vehicle registration fees (as outlined in the scenario above) per vehicle in Tucson per year or other fee/tax concepts.

Depending on the concept chosen to raise funds for the rebates, the likely effect will be a small cost to the majority of Tucson citizens who are drivers in order to provide ZEV/PHEV purchase subsidies to a very small percentage of drivers (5,835 over ten years).

Because of this revenue neutral fee/bate concept, measure costs are assumed to be zero. There is an investment in the new ZEVs and PHEVs by their owners, but the investments are offset by savings greater than the premium cost compared to a gasoline vehicle.

The costs of purchasing a new vehicle are not included as a measure cost because it is assumed that people would not purchase a new vehicle unless they needed one or could afford one – i.e. the measure does not foster more new vehicle sales than would otherwise occur.

Measure Savings

Using the energy cost projections of Westmoreland Associates for Tucson from 2011 to 2031, we have estimated the total savings accruing to the owners of the 5,835 ZEV/PHEV vehicles purchased through the measure.

In this analysis, we have made the following assumptions:

- Vehicle purchase costs: The only reduction from retail costs of ZEVs ($32,500) or PHEVs ($35,000) is a $5,000 discount. The $5,000 is the result of the measure's $3,850 rebate combined with the existing Arizona vehicle registration savings for these vehicles of ~$1,250 over five years. The cost premium is a comparison of a ZEV or PHEV to a $20,000 gasoline vehicle.

- Vehicle fuel costs: The ZEVs are assumed to achieve 4 miles per kWh; the PHEVs 80 MPGe based on 4 miles per kWh in electric mode and 66 MPG in gasoline mode. The gasoline vehicle in the comparison achieves 30 MPG. These fuel efficiencies are divided into the assumption of 10,000 miles/year to achieve fuel purchases, which are multiplied by the Westmoreland Associates projected costs for Tucson of residential electricity and gasoline.

- Maintenance costs are same as regular gasoline vehicles (in fact, they are projected to be less, but this is as yet unproven).

- Fuel savings for expected vehicle life of 10 years are subtracted from the purchase premium after the $5,000 rebate to achieve net vehicle savings per owner. Fuel savings are estimated using 5,000 miles in the first year and 5,000 miles in the 11th year, reflecting that purchases in a given calendar year will likely average six months of ownership in that year.

- The vehicles remain in City of Tucson for their lifetimes (this will not be the case, but losses are unpredictable).

Projected lifetime of vehicle fuel savings (10 years):

ZEVs:

Purchased in 2011: $10,882
Purchased in 2020: $12,708

PHEVs:

Purchased in 2011: $10,457
Purchased in 2020: $12,391

Projected purchase cost premiums for ZEVs and PHEVs:

ZEV: $32,500 less $5,000 rebate less $20,000 cost of gasoline vehicle: $7,500
PHEV: $35,000 less $5,000 rebate less $20,000 cost of gasoline vehicle: $10,000.

Net savings per vehicle (lifetime fuel savings minus purchase premium after $5,000 rebates):

ZEVs:

Purchased in 2011: $3,382
Purchased in 2020: $5,208

PHEVs

Purchased in 2011: $ 457
Purchased in 2020: $2,391

If the Pima County incentive program reaches its goal over ten years of tripling BAU estimates and stimulates 3195 additional ZEV owners and 2640 additional PHEV

owners, vehicle life ownership cost savings to Tucson owners are estimated to be: $19.65 million.

Net Economic Impact

The impact of the savings on Pima County's economy depends on the uses of the $19.65 million savings. Using a general economic development multiplier of 1.5, the gross economic impact would be a +$29.48 million through 2031, when the last of the vehicles purchased through the measure in 2020 are retired.

However, the reduction of expenditures on fuel would have some negative impact on the economy, though very little of petroleum fuel expenditures stay in the local economy because no petroleum is produced in Pima County. A reasonable estimate is a positive net impact of approximately +$9 million over ten years if the cost savings are spent locally such that the average local multiplier is 1.5.

Co-benefits (pros):

The co-benefits of tripling the BAU projections of ZEV/PHEV purchases should include:

- Providing better financial support to establishment of the electric vehicle charging infrastructure, which could result in additional net positive economic impacts if more ZEVs/PHEVs are purchased as a result of the better charging infrastructure.

- Positive economic development effects of the Pima County region having a stronger reputation for being a sustainability leader, which may influence the rapidly growing Cleantech industry to choose Pima county for job-creating business investments.

- Reduced air pollution from the increased fuel efficiencies and reduced tailpipe emissions of ZEVs/PHEVs.

Equitability:

This measure proposes providing $22.3 million in subsidies averaging $3,850 per vehicle to new vehicle purchases (i.e. one-time only per vehicle) of ZEVs and PHEVs over ten years. The equitability of this measure depends on the source of the funds.

Assuming that a person purchasing a *new* vehicle has above average income/wealth, a fee on all vehicles in Pima County that subsidizes new vehicle purchases would likely be regressive since people below average in income/wealth would be subsidizing only people who are above average.

However, if the funds were obtained by assessing fees only on the sales or registrations of new fuel-inefficient vehicles, or on inefficient vehicles valued over a certain $ amount (such as $15,000), the measure could become neutral or even progressive for Pima County / Tucson citizens.

Unintended consequences (cons):

The unintended negative consequences of this measure's success could include:

- Reduced economic activity due to the source of revenues to fund the fee-bate system. For example, if annual vehicle registration fees were collected or sales taxes increased, some people may find ways to register their vehicles or make sales-taxable purchases outside the City. However, the fees or sales taxes required are so small, this potential effect is likely to be insignificant.

- By fostering more consumer investment in efficient vehicles, the measure could divert investment capital away from other investments that are more financially efficient at reducing GHGs.

Endnotes

[1] Extrapolated by Westmoreland Associates from PAG GHG emissions statistics and projections to 2020 compared to vehicle miles traveled in the City of Tucson.

[2] Nissan press release, 22 November 2010, available at: http://www.autoguide.com/auto-news/2010/11/nissan-leaf-gets-official-99-mpg-epa-rating.html.

[3] The Motive Kestrel was designed by the manufacturer to achieve 6 miles per kilowatt hour (160 km range on 16 kWh battery), or the equivalent of 227 MPGe. It is half the weight of the Nissan Leaf's 3600 lbs., partly through use of a biocomposite body. See: http://green.autoblog.com/2010/09/02/motive-doesnt-bogart-cannabis-car-info-passes-more-us-more-det/. The Aptera is estimated to weigh 1700 lbs; its manufacturer is aiming for 200 MPG though a third party rated it at 164 MPGe; see: http://www.aptera.com/plugin.php.

[4] Nissan Leaf website, "How Far Can I Go," accessed November 2010. The website notes that the vehicle is designed for a 100 mile range.

[5] Peter Fairley, "Will Electric Vehicles Finally Succeed?", *Technology Review*, January/February 2011, pp 58-63.

[6] Argonne National Labs, GREET lifecycle energy and emissions modeling for 2008 models.

[7] Electric Power Research Institute and NRDC, "Environmental Assessment of Plug-in Hybrid Electric Vehicles, Vol. 1: Nationwide Greenhouse Gas Emissions, 2007, at: www.epri.com.

[8] Table 2 estimates are based on PHEVs averaging in between the price and performance expected from the Chevy Volt ($41,000 retail, 60 MPGe combined from 93 MPGe on batteries and 37 MPGe on gasoline) and PHEV Toyota Prius (est. $28,000 retail, testing at 90-100 MPGe combined); assuming 40% of driving done on batteries only as per EPA fuel efficiency estimates.

[9] US Department of Energy, Energy Information Administration, "Annual Energy Outlook 2010, with Projections to 2035," April 2010, at: www.eia.gov.

[10] US EIA, "Short-term Energy Outlook," 11 January 2011, at: http://www.eia.doe.gov/emeu/steo/pub/contents.html.

[11] The Electrification Coalition, "Electrification Roadmap – Revolutionizing Transportation and Achieving Energy Security," 2010, at: www.electrificationcoalition.org, p. 67.

[12] This projection is based on Tucson gasoline prices consistently being below the US average, and being ~5% below US average prices as of January 2011. The Westmoreland projections are for diesel to continue to be 16% above Tucson's gasoline price, also approximately the differential at the beginning of 2011.

[13] J.D. Power and Associates, "Drive Green 2020: More Hope Than Reality?", November 2010, at: http://businesscenter.jdpower.com/JDPAContent/CorpComm/pdfs/DriveGreen2020_110410.pdf.

[14] Richard Curtin etal., University of Michigan, "Plug-in Hybrid Electric Vehicles," 2009, at: http://www.sca.isr.umich.edu/documents.php?c=s.

[15] J.D. Power and Associates, "Drive Green 2020: More Hope Than Reality?", November 2010, at: http://businesscenter.jdpower.com/JDPAContent/CorpComm/pdfs/DriveGreen2020_110410.pdf.